Chapter 5
Remedial Accomplishments

Remedial progress during FY92 illustrated EPA's commitment to accelerate the pace of Superfund cleanup. Compared to FY91, there were an increased number of remedial activities started resulting in an increased number of remedial activities in progress at the end of the year. In addition, the Agency completed clean-up activities to place a record number of 88 National Priorities List (NPL) sites in the construction completion category, more than doubling the number of sites so categorized in the 10 previous years of the Superfund program.

This chapter highlights progress in remediating NPL sites and provides information on

- The remedial process;
- Fiscal year accomplishments;
- Remedies selected during the year;
- Fiscal year remedial initiatives;
- Efforts to develop and use innovative treatment technologies, including an evaluation of newly developed and achievable permanent treatment technologies, as required by CERCLA Section 301(h)(1)(D); and
- Results of completed five-year reviews, required by CERCLA Section 121(c) and 301(h)(1)(E), for sites where contamination remained on site after remedial action was completed.

5.1 Remedial Progress

By the end of FY92, work had occurred at nearly 96 percent of the 1,275 NPL sites. Exhibit 5.1-1 illustrates the status of the work at NPL sites, by the most advanced stage activity at each site. The remedial process used for cleaning up NPL sites and highlights of the progress made at the sites during FY92 are described below.

5.1.1 The Remedial Process

The "remedial process" refers to the cleanup of our nation's highest-priority hazardous waste sites—those placed on the NPL. It is the second of a two-phase process. The first phase is the site evaluation phase, which consists of the discovery or identification of a potential site, the preliminary assessment of the site, and the site inspection (SI). During the SI, the site is evaluated for possible listing on the NPL. If a site is listed on the NPL after the SI, it is eligible for Trust Fund financing of clean-up activities under the remedial authorities of CERCLA. Remedial activities include the following key components:

- The remedial investigation/feasibility study (RI/FS), determining the type and extent of contamination, and evaluating and developing remedial clean-up alternatives;
- The record of decision (ROD), identifying the remedy selected, based on the results of the RI/FS and public comment on the clean-up alternatives;
- The remedial design (RD), developing plans and specifications needed for the construction of the selected remedy;
- The remedial action (RA), implementing the selected remedy, including the construction of

Acronyms Referenced in Chapter 5

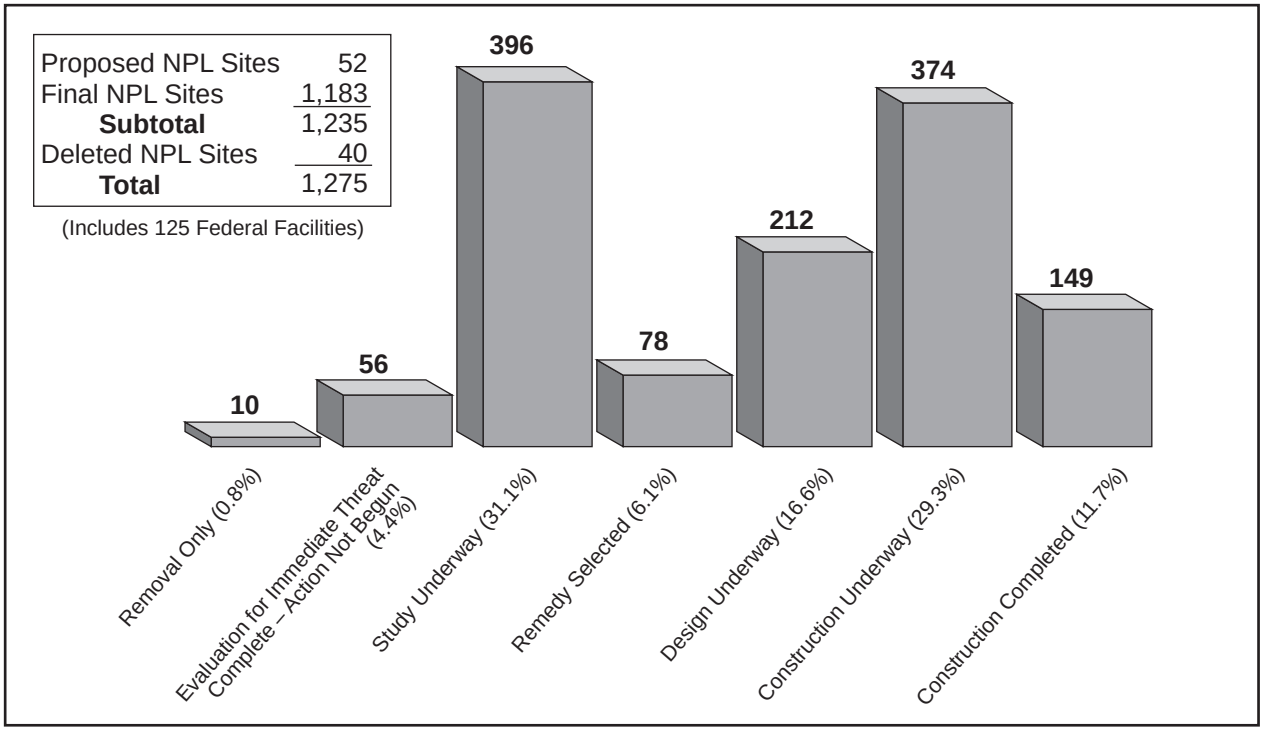
ARAR	Applicable or Relevant and Appropriate Requirement
ATTIC	Alternative Treatment Technology Information Clearinghouse
CA	Cooperative Agreement
CERCLIS	CERCLA Information System
CLU-IN	Clean-Up Information
DNAPL	Dense Nonaqueous Phase Liquid
MMTP	Monitoring and Measurement Technologies Program
NAPL	Nonaqueous Phase Liquid
NPL	National Priorities List
O&M	Operation and Maintenance
OER	Office of Exploratory Research
OERR	Office of Emergency and Remedial Response
ORD	Office of Research and Development
OSWER	Office of Solid Waste and Emergency Response
PRP	Potentially Responsible Party
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFA	Request for Application
RI/FS	Remedial Investigation/ Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
RREL	Risk Reduction Engineering Laboratory
SI	Site Inspection
SITE	Superfund Innovative Technology Evaluation
TIO	Technology Innovation Office
UV	Ultraviolet
VISITT	Vender Information System for Innovative Treatment Technologies

the remedy and the completion of the construction; and

- Operation and maintenance (O&M), assuring the effectiveness or integrity of the remedy for long-term response actions.

A Remedial Project Manager (RPM) oversees all remedial and related enforcement activities. Regional Coordinators at EPA Headquarters assist RPMs by reviewing program activities and answering technical or policy questions. To ensure that remediation is protective of human health and the environment, the RPM must be certain that the RA will attain all applicable or relevant and appropriate requirements (ARARs). ARARs are those substantive requirements of federal law and comparatively more stringent state environmental laws that legally apply to hazardous waste site cleanups.

Exhibit 5.1-1
Work Has Occurred at Most National Priorities List Sites



Source: CERCLIS; Office of Emergency and Remedial Response.

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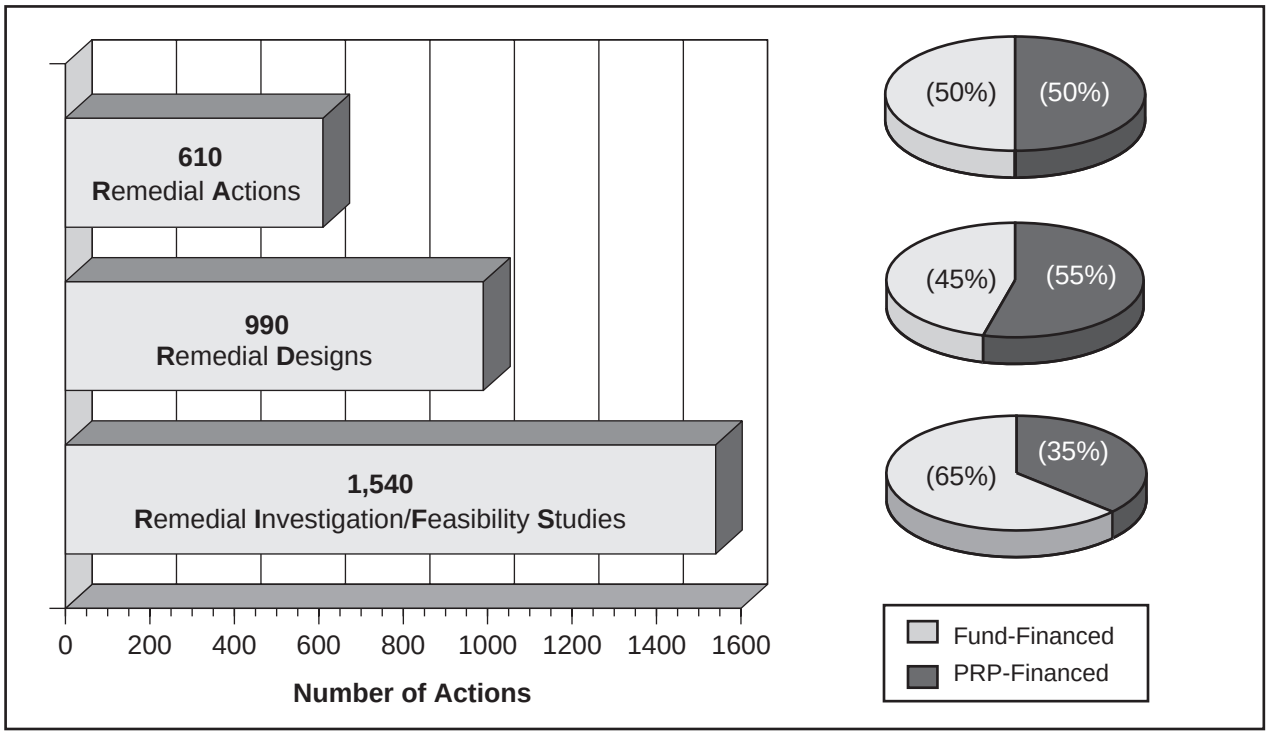
5.1.2 Fiscal Year Accomplishments

As shown in Exhibit 5.1-2, the Agency and potentially responsible parties (PRPs) had undertaken approximately 1,540 RI/FSs, 990 RDs, and 610 RAs in the Superfund program by the close of the fiscal year. The remedial accomplishments during FY92 reflect the Agency's continued efforts to accelerate the pace of cleanup, place sites in the construction completion category, and encourage PRP participation in cleanup.

- *RI/FS Starts:* During FY92, PRPs and the Agency financed the start of 90 RI/FSs; PRPs and the Agency each financed 50 percent. The number of RI/FSs started in FY92 represents a nearly 30 percent increase over the more than 70 RI/FSs started in FY91. Exhibit 5.1-3 illustrates this comparison of RI/FS accomplishments.
- *RD Starts:* As shown in Exhibit 5.1-4, the Agency or PRPs started 170 RDs in FY92; PRPs financed approximately 70 percent and the Agency financed 30 percent. The number of RDs started in FY92 represents a more than 5 percent increase over the 160 RDs started in FY91.
- *RA Starts:* PRPs and the Agency financed the start of 110 RAs during FY92; PRPs financed more than 70 percent, and the Agency financed 30 percent. The 110 RAs started in FY92 represent an almost 10 percent increase over the 100 RAs started in FY91. Exhibit 5.1-5 illustrates this comparison of RA accomplishments.
- *Construction Completions:* The Agency placed a record 88 NPL sites in the construction completion category during FY92, bringing the Superfund program total to 149. The significant

Exhibit 5.1-2
Remedial Accomplishments under the Superfund Program for Fiscal Year 1980 Through Fiscal Year 1992



Source: CERCLIS; Office of Emergency and Remedial Response.

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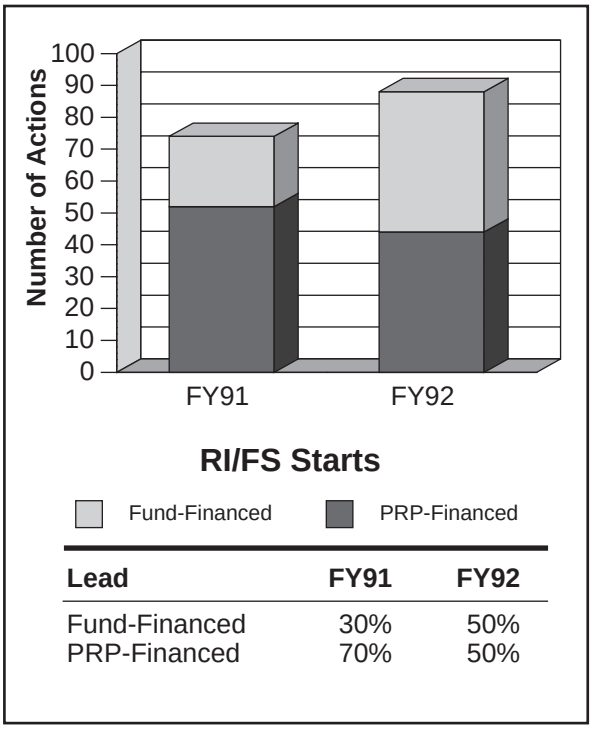
Exhibit 5.1-3
Comparison of Remedial Investigation/Feasibility Study Starts



Lead	FY91	FY92
Fund-Financed	30%	50%
PRP-Financed	70%	50%

Source: CERCLIS; Office of Emergency and Remedial Response.

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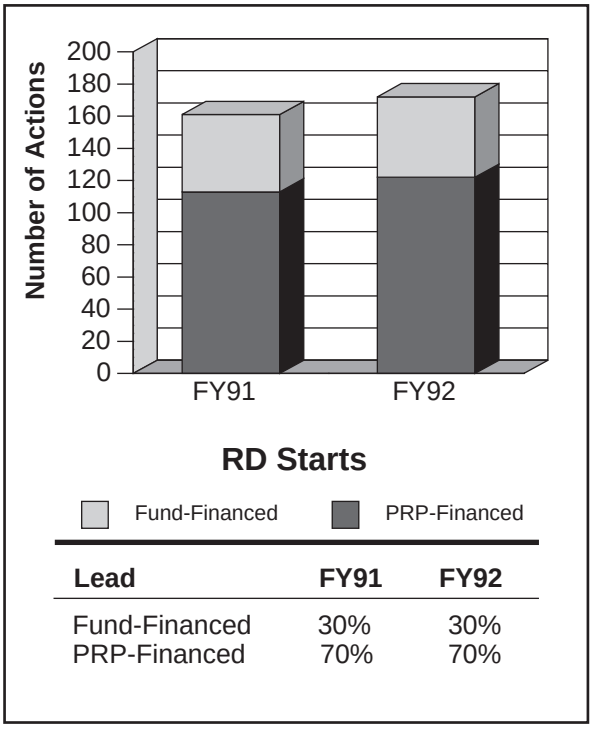
Exhibit 5.1-4
Comparison of Remedial Design Starts



Lead	FY91	FY92
Fund-Financed	30%	30%
PRP-Financed	70%	70%

Source: CERCLIS; Office of Emergency and Remedial Response.

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rise in completions during FY92 reflects the increasing emphasis on completing construction at sites and the streamlining of documentation requirements.

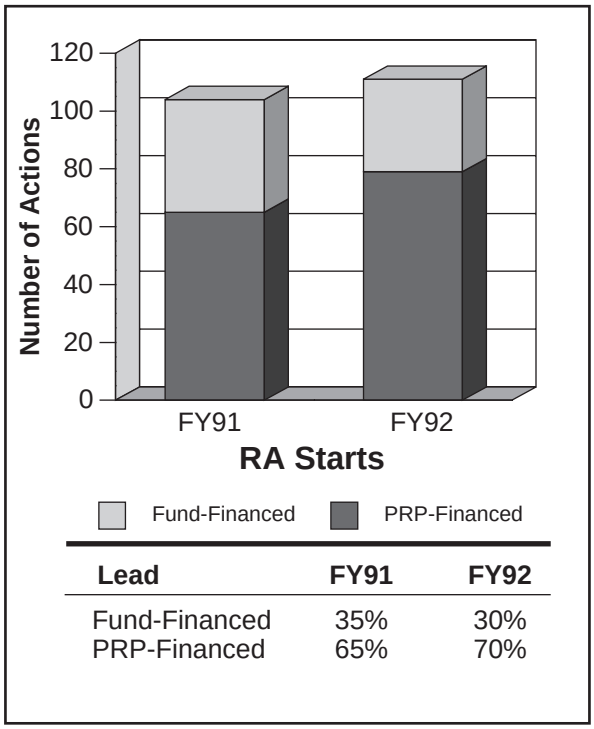
- *PRP Involvement:* PRPs' financing of more than 70 percent of the RDs and RAs started in FY92 exhibits the Agency's successful efforts to compel PRPs to participate in clean-up activities. Additional information on PRP involvement in Superfund cleanup is provided in Chapter 6.

In addition to these Fund-financed and PRP-financed activities, other federal agencies or departments, states, and Indian tribes financed or assumed the lead for response activities. These accomplishments are discussed in Chapters 7 and 8.

5.1.3 Status of Remedial and Enforcement Activities in Progress

At the end of FY92, 1,274 RI/FS and RA projects were in progress at 751 NPL sites, compared with 1,196 RI/FSs and RAs at 750 NPL sites at the end of FY91. FY92 projects included 920 RI/FSs and 354 RAs. As required by CERCLA Sections 301(h)(1)(B), (C), and (F), a listing of projects in progress at the end of FY92 is provided in Appendix A, along with their projected completion schedule. There were also 412 RDs in progress at the end of FY92, compared with 374 RDs in progress at the end of FY91. A listing of all RDs in progress at the end of FY92 is provided in Appendix B.

Exhibit 5.1-5
Comparison of Remedial Action Starts



Lead	FY91	FY92
Fund-Financed	35%	30%
PRP-Financed	65%	70%

Source: CERCLIS; Office of Emergency and Remedial Response.

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Of the 1,274 RI/FS and RA projects in progress at the end of the FY92, 208 were on schedule. In addition, 45 projects were ahead of schedule and 322 projects were started during the fiscal year. Projects behind schedule totaled 596, and 103 projects had no previously published estimated date of completion. Exhibit 5.1-6 identifies the number of projects in progress at the end of FY91 and FY92 at NPL sites by lead.

PRPs were conducting 481 of the RI/FS and RA projects in progress at the end of FY92, including 310 RI/FSs and 171 RAs. Of these 481 PRP-financed projects, 74 were on schedule. In addition, 11 projects were ahead of schedule and 121projects were started during the fiscal year. Projects behind schedule totaled 238, and 37 projects had no previously published estimated date of completion.

The status of RI/FSs and RAs in progress is based on a comparison of each project's planned completion date in the CERCLA Information System (CERCLIS) at the end of FY91 with the planned completion date in CERCLIS at the end of FY92. An initial completion schedule is included when a remedial activity is entered into CERCLIS. Minimal site-specific information is available when the initial completion schedule is determined, and Regions usually rely on standard planning assumptions (e.g., 12 quarters for an RI/FS). As work continues, schedules are adjusted to reflect actual site conditions.

5.2 Remedy Selection

The Agency signed 172 RODs in FY92, including 126 new and amended RODs for Fund-financed and PRP- financed sites and 46 RODs for federal facility sites.

The ROD documents the results of all studies performed on the site, lists the remedies selected to clean up the site, and identifies each remedial alternative that the Agency considered. The ROD is signed after completion of the RI/FS, and after the public has had the chance to comment on the remedial alternatives under consideration. The Agency selected a variety of remedies in fiscal year RODs, based on a careful analysis of characteristics unique to each site and the proximity of each site to people and sensitive environments. (Wetlands and endangered wildlife are examples of environmental resources that are taken into consideration when evaluating remedies.)

Congress, with the enactment of SARA, sent EPA a clear message to give preference to treatment rather than containment remedies. Exhibit 5.2-1 lists the number and types of source control treatment and containment remedies selected in FY92 RODs. It also identifies the number of remedies selected for addressing contaminated ground water. Exhibit 5.2-2 represents the 172 FY92 RODs by percentage comparison based on the type of remedies selected.

The list of the 172 RODs signed during FY92 is provided in Appendix C. To fulfill the requirement of CERCLA Section 301(h)(1)(A) to provide an abstract of each feasibility study (e.g., ROD), a summary of each FY92 ROD is available in the publication *ROD Annual Report FY 1992*.

Exhibit 5.1-6
Projects in Progress at National Priorities List Sites by Lead for Fiscal Year 1991 and Fiscal Year 1992

	RI/FS		RDs		RAs	
	FY91	FY92	FY91	FY92	FY91	FY92
Fund-Financed—State-Lead	42	37	22	22	29	29
Fund-Financed—Federal-Lead[1]	181	153	121	104	103	105
Fund-Financed—EPA Performs Work at Site[2]	19	15	3	4	2	2
PRP-Financed and PRP-Lead	253	259	186	233	133	151
Mixed Funding—Monies from Fund and PRPs	0	2	5	3	6	7
PRP-Financed—State Order and EPA Oversight[3]	65	51	15	15	14	20
State Enforcement	0	3	0	0	0	0
Federal Facility	329	400	22	31	20	40
Total	**889**	**920**	**374**	**412**	**307**	**354**

[1] Includes remedial program-lead projects and enforcement program-lead projects.
[2] Projects at which EPA employees, rather than contractors, perform the site clean-up work.
[3] Projects where site clean-up work is financed and performed by the PRPs under state order, with EPA oversight.

Sources: *Progress Toward Implementing Superfund:* FY91 (Appendices A and B) and FY92 (Appendices A and B). 51-013-18D

5.3 REMEDIAL INITIATIVES

Continuing efforts initiated under the 30-Day Study to streamline remedial activities, the Agency worked to develop presumptive remedies, standard soil trigger levels, and guidance defining "construction completion" site status. The Agency also issued a final directive on ground-water remediation.

30-Day Study Initiatives

The 30-Day Study Task Force recommended several measures to improve remedial activities.

- *Presumptive Remedy Selection:* Presumptive remedies will streamline the remedy selection process by identifying standard remedies for specific types of sites. The Agency began to work to develop guidance on presumptive remedies during FY92. The public, state, or PRPs may also propose use of other approaches based on site-specific technical information or on local or state concerns.
- *Standardized Soil Trigger Levels:* The 30-Day Study Task Force found that the existing procedure for establishing different soil clean-up levels for each site was complex and time-consuming. To expedite the process, the Agency began developing methods for determining standard soil trigger levels, which may serve as clean-up levels under certain circumstances. During FY92, the Agency began work on soil trigger levels for the top 30 priority chemicals found at Superfund sites.
- *Construction Completion Policy:* On February 19, 1992, EPA announced new procedures for defining the construction completion category for NPL sites (Office of Solid Waste and Emergency Response (OSWER) Directive 9320.2-3C). "Construction completion" is a single

Exhibit 5.2-1
Summary of Remedies Selected in Fiscal Year 1992 Records of Decision[1]

Source Control Remediation	Total Number of Occurrences
Treatment Technology[2]	
Thermal Destruction/Incineration	10
Immobilization	37
In situ Vacuum/Vapor Extraction	20
Soil Washing	4
Thermal Desorption	4
Bioremediation[3]	13
To Be Determined/Unspecified Treatment	13
In situ Vitrification	0
Dechlorination	0
Soil Flushing	4
Volatilization/Aeration	0
Solvent Extraction	1
Chemical Treatment	1
TOTAL	**107**
Other Treatment	
Decontamination	18
Recovery/Recycling	9
Surface Water Treatment	20
NAPLs Treatment	8
Gas Flaring	4
TOTAL	**59**
Containment Only	
On-site	21
Off-site	8
TOTAL	**29**
Other Actions (e.g., Institutional Controls, Relocation)	7
Contaminated Ground-Water Remediation	**Total Number of Occurrences**
Active Restoration	
Physical/Chemical	139
Biological	10
To Be Determined/Unspecified Treatment	18
Publicly Owned Treatment Works	12
TOTAL	**179**
Alternate Water Supply	7
Natural Attenuation	12
Leachate Treatment	10
Containment[4]	8
Other Actions (Institutional Controls)	5
No Further Action	25

[1] Based on 172 FY92 RODs, including 46 federal facility RODs and 8 ROD amendments. Includes 85 final and 34 interim action RODs, and 25 no action RODs; more than one remedy may be associated with a ROD.

[2] Includes primary and contingent treatment technologies. Data reflects occurrences of technologies as selected in the 119 RODs that addressed source control; more than one technology may be associated with a ROD.

[3] Includes *in situ* and *ex situ* processes.

[4] Includes management of migration.

Source: Office of Emergency and Remedial Response/Hazardous Site Control Division.

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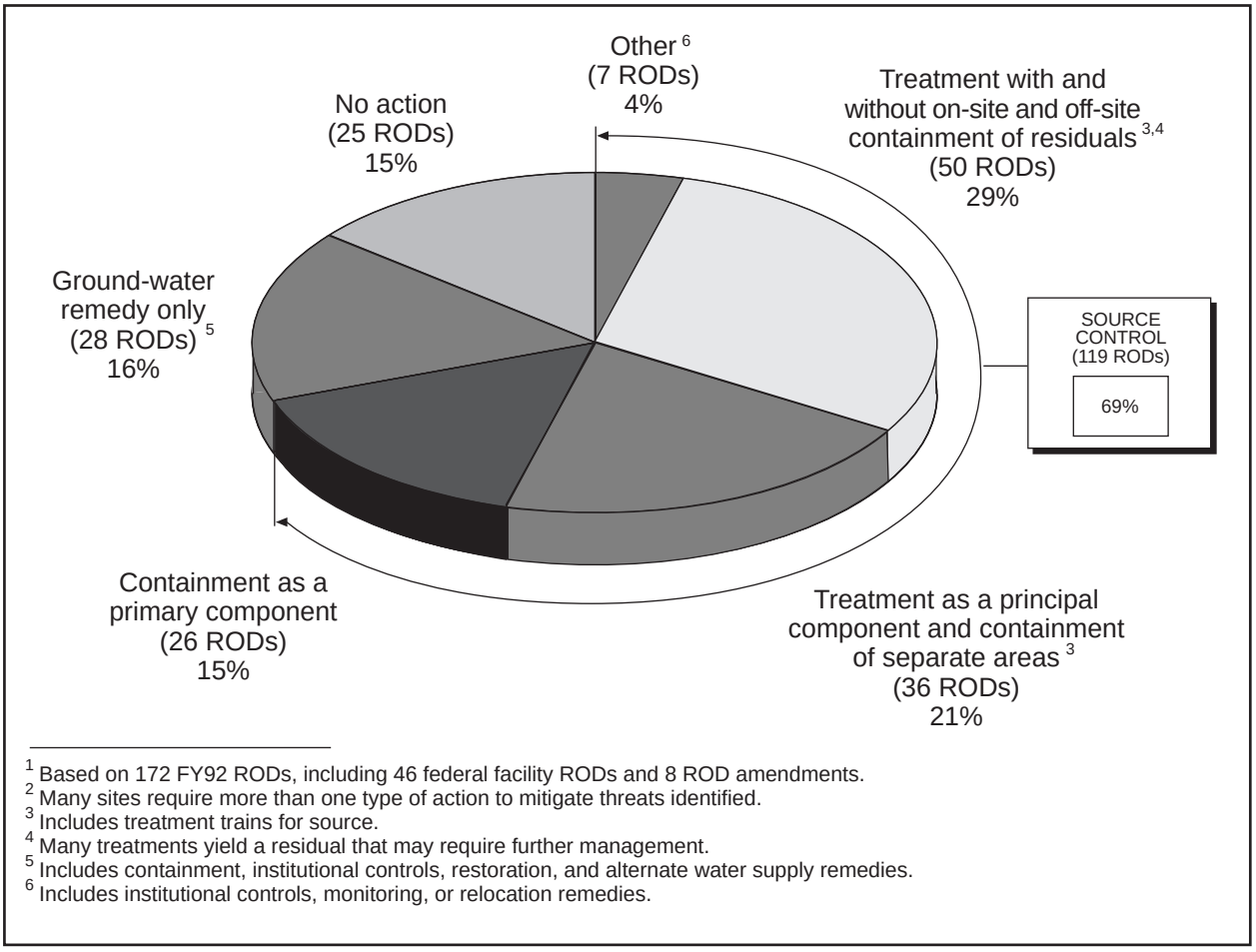
Exhibit 5.2-2
Percentage Distribution of Remedies Selected In Fiscal Year 1992 Records of Decision[1,2]



[1] Based on 172 FY92 RODs, including 46 federal facility RODs and 8 ROD amendments.
[2] Many sites require more than one type of action to mitigate threats identified.
[3] Includes treatment trains for source.
[4] Many treatments yield a residual that may require further management.
[5] Includes containment, institutional controls, restoration, and alternate water supply remedies.
[6] Includes institutional controls, monitoring, or relocation remedies.

Source: Office of Emergency and Remedial Response/Hazardous Site Control Division. 51-013-42J

category in which all completed sites can be listed. Sites may be placed into the construction completion category when all necessary physical construction of the remedy is complete, whether or not final clean-up levels have been achieved; EPA has determined that the response action should be limited to measures that do not involve construction; or the site qualifies for deletion or has been deleted from the NPL.

Additional information on these initiatives is provided in Chapter 1.

Final Directive on Ground-Water Remediation

In May 1992, OSWER issued an updated ground-water remediation policy directive entitled, *Considerations in Ground-Water Remediation at Superfund Sites and RCRA Facilities—Update*. The final directive builds on previous policies and uses lessons learned from Superfund clean-up efforts to address special ground-water clean-up problems posed by nonaqueous phase liquid (NAPL) contaminants—organic compounds that do not readily mix with water. NAPLs, particularly dense NAPLs (DNAPLs), pose special problems because

they can be long-term sources of ground-water contamination. DNAPLs are difficult to locate and remediate in the subsurface.

The policy promotes a consistent remedial approach at both Superfund sites and Resource Conservation and Recovery Act (RCRA) corrective action facilities. The policy provides recommendations concerning site characterization approaches, appropriate early actions, and remedial approaches.

5.4 Use and Development of Treatment Technologies

CERCLA requires that EPA give preference to treatment remedies that reduce the toxicity, mobility, and volume of waste at a site. To ensure that a broad range of treatment technologies is available for use at Superfund sites, the Agency works to expand the pool of proven, cost-effective, and technically sound innovative treatment technologies and increase the availability of, and access to, information about them.

The Office of Research and Development (ORD) contributes to the development of treatment technologies through its Superfund Innovative Technology Evaluation (SITE) program. As part of this program, ORD invites technology developers to demonstrate new, innovative technologies on waste from NPL sites. ORD also awards research grants and contracts through its Office of Exploratory Research (OER).

To promote the application of clean-up technologies, EPA emphasizes the role of the Technology Innovation Office (TIO) in encouraging innovation. TIO uses booklets, journals, databases, and conferences to alert project managers, engineers, academics, contractors, and other interested parties to the availability of new technologies. ORD also supports information transfer activities, including seminars, bulletins, and computer systems, and supplies technical assistance to the federal, state, and public sectors in evaluating potentially applicable treatments.

5.4.1 The Superfund Innovative Technology Evaluation Program

In 1986, to help satisfy the CERCLA requirement for preference of treatment remedies, EPA's OSWER and ORD established the SITE program. ORD's Risk Reduction Engineering Laboratory (RREL), headquartered in Cincinnati, Ohio, administers the SITE program. The goal of the program is the development, demonstration, and subsequent application of new treatment technologies.

The SITE program, in its seventh year as of FY92, has been an integral part of EPA's research into alternative clean-up methods for hazardous waste sites. Under the program, EPA awards cooperative agreements (CAs) to technology developers. These developers then refine their innovative technologies during bench- or pilot-scale tests and may demonstrate them, with support from EPA, at hazardous waste sites. EPA collects and publishes engineering, performance, and cost data on the technologies tested through the program to aid in future decision making for hazardous waste site remediation.

The successful implementation of innovative technologies requires a team approach. SITE program staff members work closely with EPA's Regional offices, states, technology developers, the Superfund Technology Assistance Response Team, and OSWER to provide technology demonstrations and to disseminate information. The SITE program also uses EPA research facilities, such as the Test and Evaluation Facility and the Center Hill Facility in Cincinnati, Ohio, to evaluate innovative technologies.

Operational Areas

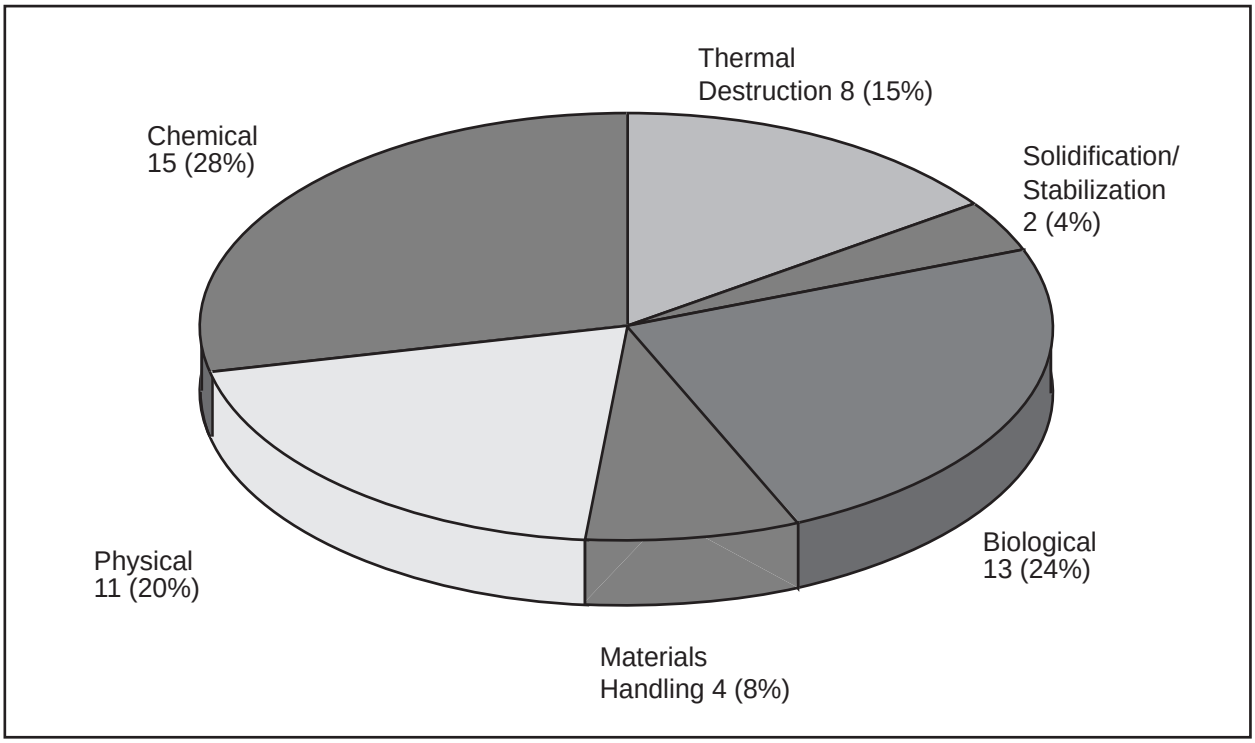
The SITE program is divided into four operational areas: emerging technologies, demonstrations, monitoring/measurement, and technology transfer.

Emerging Technologies Program: EPA provides technical and financial support to developers for bench- and pilot-scale testing and evaluating of innovative technologies that have been, at a minimum, proven on the conceptual or bench-scale level. The intent is that, following this initial testing, technologies will advance to the more rigorous testing of the

Demonstration Program. The Emerging Technologies Program compares the applicability of particular technologies to Superfund site waste characteristics. Each technology's performance is documented in a final report, project summary, and bulletin. In response to the FY91 solicitation, nine new technologies were accepted in the Emerging Technologies Program in FY92, bringing the total number to 53. Exhibit 5.4-1 provides a percentage breakdown, by treatment technique, of the technologies tested in the Emerging Technologies Program through FY92.

Demonstration Program: Promising innovative technologies are field-tested on hazardous waste materials. Engineering and cost data are gathered on the technologies so that potential users can assess their applicability to a particular site cleanup. Data collected during the field demonstration are used to assess the performance of the technologies, the potential need for pre- or post-processing of the waste, applicable types of wastes and waste matrices, potential operating problems, and approximate capital and operating costs. During FY92, 19 new technologies were accepted into the Demonstration Program, including 8 from the annual request for proposal, 4 from the Emerging Technologies Program, 1 developed by EPA, 2 from nominations by EPA Regional offices and other federal agencies, and 4 from other sources. As of December 1992, the program included 94 technology projects, 15 of which were demonstrated in FY92. Exhibit 5.4-2 provides a percentage breakdown by treatment technique of technologies in the Demonstration Program as of FY92.

Exhibit 5.4-1
Innovative Technologies in the Emerging Technology Program



Source: Office of Research and Development.

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Monitoring and Measurement Technologies Program (MMTP): The goal of this program is to assess innovative and alternative monitoring, measurement, and site characterization technologies. During FY92, 14 technologies were demonstrated, each evaluating one or more monitoring and measurement techniques.

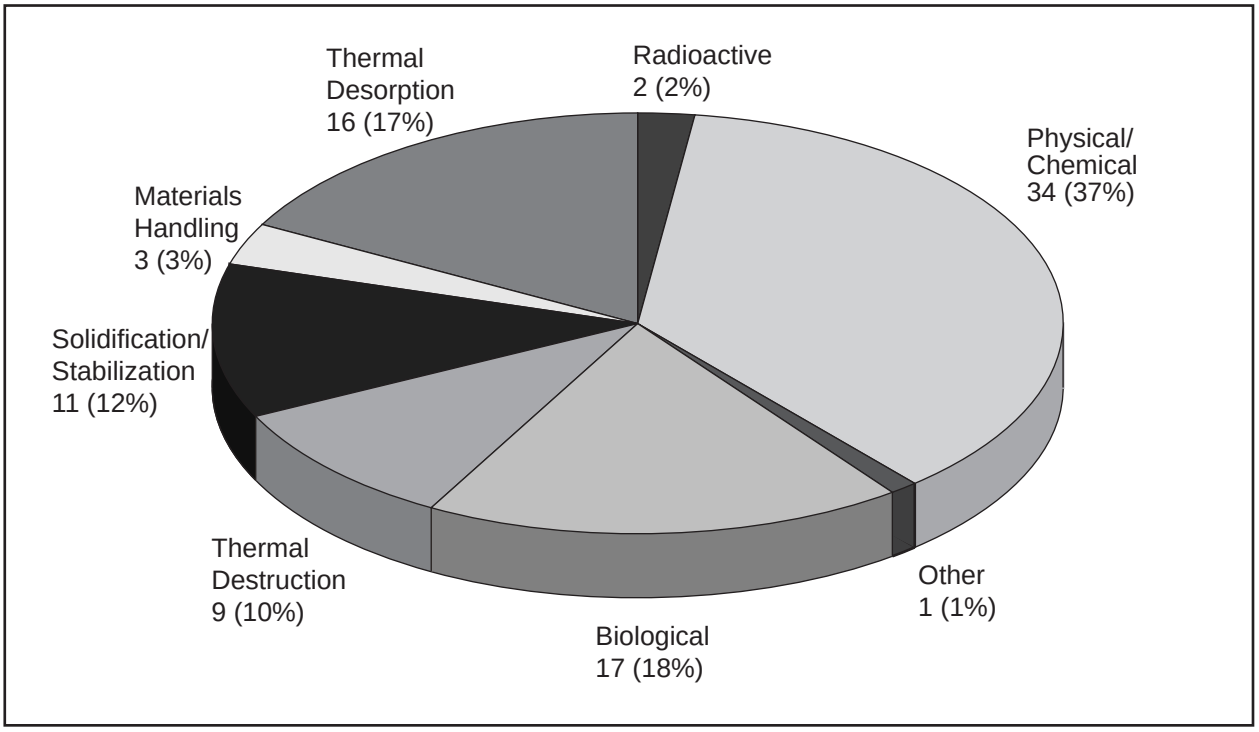
Technology Transfer Program: Technical information on innovative technologies in the Emerging Technologies Program, Demonstration Program, and MMTP is disseminated through various activities. The Agency provides this information to increase the awareness and promote the use of innovative technologies for assessment and remediation at Superfund sites, and to encourage communication among individuals who require up-to-date technical information.

Fiscal Year 1992 Demonstrations of Innovative Treatment Technologies

To evaluate new treatment technologies, 14 developers completed 15 field demonstrations during FY92, bringing the total number of demonstrations that have been completed under the SITE Demonstration Program to 44. The demonstrations completed in FY92 are summarized below.

Accutech Remedial Systems, Inc., has developed an integrated treatment system incorporating pneumatic fracturing extraction (PFE) and hot gas injection (HGI). The system provides a cost-effective accelerated remedial approach to sites with DNAPL-contaminated ground-water aquifers. The patented PFE process, which has been demonstrated at several sites, increases and equalizes subsurface airflow

Exhibit 5.4-2
Innovative Technologies in the Demonstration Program



Source: Office of Research and Development.

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within low permeability formations, such as clay and fractured rock, to enhance contaminant mass removal. This technology was accepted into the SITE Demonstration Program in December 1990 and was demonstrated during July and August 1992 at a New Jersey Environmental Clean-Up Responsibility Act site in South Plainfield, New Jersey.

Babcock and Wilcox Co.'s cyclone vitrification technology is designed for the combustion of highly contaminated hazardous wastes, such as sludge and soil containing heavy metals and organic constituents. The waste may be in solid, soil sludge, or liquid form. The technology captures heavy metals in the slag and renders them nonleachable. An important application of the process is treatment of soil that contains low-volatility radionuclides. The technology was accepted into the SITE demonstration program in August 1991, and the demonstration was completed in Alliance, Ohio, in November, 1991.

Bergmann USA's soil and sediment washing technology separates contaminated particles by density and grain size. The technology operates on the hypothesis that most contamination is concentrated in fine particles and that contamination of larger particles is generally not extensive. In this technology, contaminated soil is screened to remove coarse rock and debris. Water and chemicals are added to the soil to produce a slurry feed, which flows to an attrition scrubbing machine. Rotary trommel screws, dense media separators, and other equipment create mechanical and fluid shear stress, removing contaminated silt and clay from granular soil particles. Different separation processes then create output streams consisting of granular soil, silt and clay, and wash water. This technology was accepted into the SITE Demonstration Program in 1991. It was field evaluated in Toronto, Ontario, in April 1992 and Saginaw, Michigan, in May 1992.

BioGenesis Enterprises, Inc., has developed a process that uses a specialized truck, a complex surfactant, and water to clean soil contaminated with organics. Ancillary equipment includes gravity oil and water separators, coalescing filters, and a bioreactor. All equipment used in the process is mobile, and treatment normally occurs on site. A single wash removes 85 to 99 percent of hydrocarbon contamination. High concentrations require additional washes. The BioGenesis technology, accepted into the SITE Demonstration Program in June 1990, was first demonstrated in Santa Monica, California, in May 1992.

Brice Environmental Services Corporation's soil washing plant is a portable, cost-effective, above-ground process for reducing the overall volume of contaminated soil that will require treatment. The demonstration plant is contained on an 8-by-40-foot trailer and transported with a pickup truck. The system uses conventional mineral processing equipment for deagglomeration, density separation, and material sizing, centered around a patented process for effective fine particle separation. The processing rate depends on the percentage of soil fines in the feed material. The soil washing plant was accepted into the SITE Demonstration Program in late 1991. During the SITE demonstration, which was conducted in late summer 1992 at the Alaskan Battery Enterprises Superfund site in Fairbanks, Alaska, the system processed between 2.5 and 5 tons of contaminated soil per hour. The unit can, however, operate at up to 20 tons per hour.

Canonie Environmental Services has developed a low-temperature desorption process known as low temperature thermal aeration (LTTA) technology. It removes organic contaminants from soil into a contained air stream, which is extensively treated to either collect the contaminants or to thermally destroy them. A direct-fired rotary dryer is used to heat the air stream which, by direct contact, desorbs water and organic contaminants from the soil. A second air stream treatment system can treat soil containing high concentrations of petroleum hydrocarbons. The treated soil, after meeting the treatment criteria, can be backfilled on site without restrictions. The process generates no waste water or waste soil. The LTTA technology was accepted into the SITE Demonstration Program in summer 1992. A demonstration was performed

on soil contaminated with organochlorine pesticides at a pesticide site in Arizona during September 1992.

Chemical Waste Management, Inc.'s "PO*WW*ER" technology is used for treatment and volume reduction of complex industrial and hazardous waste waters containing mixtures of inorganic salts, metals, volatile and nonvolatile organics, volatile inorganics, and radionuclides. The proprietary technology combines evaporation with catalytic oxidation to concentrate and destroy contaminants, producing high-quality water. The "PO*WW*ER" technology treats a wide spectrum of contaminants, produces high-quality effluent, destroys volatile pollutants, and achieves a high-volume reduction. The technology was accepted into the SITE Demonstration Program in 1991. It was tested on landfill leachate in September 1992 at the developer's pilot plant in Lake Charles, Louisiana.

Chemical Waste Management, Inc., has also developed the "X*TRAX" technology, a thermal desorption process that removes organic contaminants from soil, sludge, and other solid media. It is not an incinerator or a pyrolysis system. Chemical oxidation and reactions are not encouraged, and no combustion by-products are formed. The organic contaminants are removed as a condensed liquid, characterized by a high heat rating, which may then be either destroyed in a permitted incinerator or used as a supplemental fuel. Because of low operating temperatures and gas flow rates, this process is less expensive than incineration. This technology was accepted into the SITE Demonstration Program in summer 1989. EPA conducted a SITE demonstration of the technology at the Re-solve, Inc., Superfund site in Massachusetts in May 1992.

EPOC Water, Inc.'s precipitation, microfiltration, and sludge dewatering treatment process uses a combination of processes to treat a variety of wastes. In the first step of the process, heavy metals are chemically precipitated. Precipitates and all particles larger than 0.1 to 0.2 micron are filtered through a unique fabric crossflow microfilter (EXXFLOW). The concentrate stream is then dewatered in an automatic tubular filter press of the same fabric material (EXXPRESS). The EXXFLOW/EXXPRESS demonstration unit, which is transportable and mounted on skids, is designed to process approximately 30 pounds of solids per hour and 10 gallons of waste water per minute. The technology was accepted into the SITE Demonstration Program in 1989. Bench-scale tests were conducted in 1990, and the SITE demonstration was conducted in May 1992 on highly acidic mine drainage at the Iron Mountain Superfund site in Redding, California.

Peroxidation Systems, Inc., designed the perox-pure technology to destroy dissolved organic contaminants in ground water or waste water through an advanced chemical oxidation process using ultraviolet (UV) radiation and hydrogen peroxide. Hydrogen peroxide is added to the contaminated water, and the mixture is then fed into the treatment system. UV light catalyzes chemical oxidation of organic contaminants in water by its combined effect upon the organics and reaction with hydrogen peroxide. Many organic contaminants that absorb UV light may undergo a change in their chemical structure or become more reactive with chemical oxidants. More importantly, UV light catalyzes the breakdown of hydrogen peroxide to produce hydroxyl radicals, which are powerful chemical oxidants. Hydroxyl radicals react with organic contaminants, destroying them and producing harmless by-products such as carbon dioxide, halides, and water. The process produces no hazardous by-products or air emissions. This technology was accepted into the SITE Demonstration Program in April 1991. A demonstration took place in September 1992 at the Lawrence Livermore National Laboratory Site 300 Superfund site.

Resources Conservation Company developed the Basic Extraction Sludge Technology ("BEST") process, a mobile solvent extraction system that uses one or more secondary or tertiary amines to separate organics from solids and sludges. The BEST process begins by mixing and agitating the cold solvent and waste in a cold extraction tank. Solids from the cold extraction tank are transferred to the extractor/dryer, a horizontal steam-jacketed vessel with rotating paddles. The solvent mixture created by this process is then heated. As the mixture's temperature increases, the water separates from the organics and solvent.

The organics-solvent fraction is decanted and sent to a stripping column, where the solvent is recycled. The organics are discharged for recycling or disposal, and the water is passed to a second stripping column where residual solvent is recovered for recycling. The water is then typically discharged to a local waste-water treatment plant. The BEST technology was accepted into the SITE Program in 1987, and was demonstrated in July 1992 at the Grand Calumet River.

Roy F. Weston has developed the low-temperature thermal treatment (LT) system that thermally desorbs organic compounds from contaminated soil without heating the soil to combustion temperatures. The LT system consists of three parts: soil treatment, emissions control, and water treatment. Accepted into the SITE demonstration program in September 1991, the system was demonstrated as part of a proof-of-process test for full-scale remediation of lagoon sludge at a Superfund site in Adrian, Michigan, during November and December 1991.

RREL/University of Cincinnati developed a hydraulic fracturing process that creates fractures in silty clay soil to enhance the permeability. The technology creates sand-filled horizontal fractures up to one inch in thickness and 20 feet in radius. These fractures are then placed at multiple depths ranging from 5 to 30 feet below ground surface to enhance the efficiency of treatment technologies such as soil vapor extraction, *in situ* bioremediation, and pump-and-treat systems. The technology was accepted into the SITE program in July 1991 and was demonstrated in Cincinnati, Ohio, in September 1992.

SoilTech ATP Systems, Inc.'s anaerobic thermal processor is a thermal desorption process. Contaminated soil, sludge, and liquid are heated and mixed in a special, indirectly fired rotary kiln. The unit desorbs, collects, and recondenses hydrocarbons and other pollutants found in contaminated material. The unit can also be used in conjunction with a dehalogenation process to destroy halogenated hydrocarbons through a thermal and chemical process. This technology was accepted into the SITE Demonstration Program in March 1991, and has been shown at two SITE demonstrations. At the second demonstration, completed in June 1992, a full-scale unit remediated soils at the Outboard Marine Corporation site in Waukegan, Illinois.

Toronto Harbor Commission has developed a soil recycling process that removes inorganic and organic contaminants in soil to produce a reusable fill material. The process involves three technologies operating in a series. The first technology is a soil washing process that reduces the volume of material to be treated by concentrating contaminants into a fine slurry mixture. The second technology removes heavy metals from the slurry through a process of metal dissolution. The third technology, chemical hydrolysis accompanied by a biodegradation process, destroys organic contaminants concentrated in the slurry. The three integrated technologies are capable of cleaning contaminated soil for reuse on industrial sites. The Toronto Harbor Commission's soil recycling process was accepted into the SITE Demonstration Program in 1991. Demonstration sampling took place in April and May 1992.

5.4.2 Superfund Research Grants

Various sources of funding are available for Superfund-related research. One of the funding programs administered by OER is the Research Grants Program, which provides funding for research in environmental projects related to health, engineering, physics, chemistry (with separate categories for air and water), biology, and Superfund. Researchers submit applications in response to an annual solicitation.

In FY92, the Research Grants Program published a request for applications (RFA) for "Improved Pump-and-Treat Processes for Remediation of Superfund Sites." The major emphasis was on treating sites polluted by DNAPLs, including some halogenated organic solvents. Of 32 applications received in response to the RFA, the peer panel of 20 engineers judged 12 applications to be fundable. The top five applications were each funded for two years; total funding was $1.4 million.

5.4.3 Technical Assistance, Expert Advice, and Information Transfer

To encourage their use, the Agency has increased the availability of information on innovative treatment technologies. The Agency has developed several electronic information sources, publications, and training and professional development opportunities to provide more organized and targeted information.

Electronic Information Sources

The three principal EPA electronic sources of information on innovative treatment technologies are the Alternative Treatment Technology Information Clearinghouse (ATTIC), the Vendor Information System for Innovative Treatment Technologies (VISITT), and Clean-Up Information (CLU-IN):

- ATTIC, developed and implemented by ORD, integrates hazardous waste data in a centralized, searchable source that may be accessed by federal, state, and public sector users. By the end of FY92, ATTIC contained data from more than 2,400 references. Since its inception in 1989, user requests to ATTIC have increased from 120 to more than 1,000 per month.
- VISITT contains vendor-submitted performance and cost information. As of FY92, VISITT included information on 155 innovative treatment technologies offered by 97 developers and vendors. TIO provides this database on diskettes to interested potential users of innovative technologies. Since its initial development in FY91, TIO has distributed nearly 7,000 diskettes.
- CLU-IN's electronic bulletin board services offer a variety of information pertaining to innovative treatment technologies, including *Federal Register* notices regarding hazardous waste, listings of EPA publications, training program schedules, information on requests for proposals for environmental clean-up work, and a directory of EPA hazardous waste site clean-up experts.

Publications

TIO and ORD have developed a number of publications that provide information on new developments and the application of innovative treatment technologies:

- *Innovative Treatment Technologies: Semi-Annual Status Report* is a booklet that documents the selection and use of innovative treatment technologies at Superfund sites and provides technical background information. The booklet is designed to enhance communication between vendors, experienced technology users, and those who are considering innovative treatment technologies to clean up contaminated sites.
- *Tech Trends* and *Ground-Water Currents* are two quarterly bulletins published by TIO on soil remediation technologies and ground-water remediation technologies, respectively. As of FY92, these newsletters were being distributed to more than 9,000 interested subscribers, including federal and state project managers, consulting engineers, and PRPs.
- *Innovative Hazardous Waste Treatment Technologies: A Developer's Guide to Support Services* provides information to developers to assist them in developing, testing, and commercializing innovative technologies.
- *Citizen's Guides to Innovative Treatment Technologies* is a 10-volume set of publications directed toward community leaders and the interested public. The guides provide basic, readable information on technologies that may be used to clean up Superfund, RCRA corrective action, or underground storage tank sites. The guides are available in both English and Spanish.

Training and Professional Development Opportunities

TIO works with the Air and Waste Management Association, the Hazardous Waste Action

Coalition, and several other organizations to develop satellite video seminars on innovative treatment technologies. The seminars are downlinked to more than 60 locations in the United States and Canada. The four-hour seminars are targeted at federal, state, and private project managers and feature panels of technical experts in a question-and-answer format. Video topics offered through FY92 included bioremediation, bioventing, soil-vapor extraction, and thermal desorption.

In another training initiative, EPA, the California Environmental Protection Agency, the Department of Energy, and the U.S. Army Corps of Engineers hosted a conference, *The Fourth Forum on Innovative Hazardous Waste Treatment Technologies: Domestic and International*, in November 1992. The aim of the conference was to increase the awareness in the user community of technologies that are available for application. Through technical papers and poster displays, the conference introduced domestic and international innovative hazardous waste treatment technologies. Conference attendance has increased over time: approximately 800 people attended the conference in 1991 and more than 1,100 people attended in 1992.

5.5 Report on Facilities Subject to Review Under CERCLA Section 121(c)

Certain selected remedies permit hazardous substances, pollutants, or contaminants to remain on site if they do not threaten human health or the environment. CERCLA Section 121(c) requires that EPA review sites where the Agency selected such a remedy no less often than every five years after the initiation of the RA to ensure that the remedy fully protects human health and the environment. CERCLA Section 121(c) also requires that a report be submitted to Congress that lists the required facilities for which periodic reviews are required, the results of all the reviews, and any action taken as a result of the reviews. FY92 was the second year in which sites became eligible for the five-year review.

The Agency has issued guidance entitled *Structure and Components of Five-Year Reviews*, which defines the scope of five-year reviews and identifies two types of reviews: statutory reviews (required by CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan) and policy reviews (those that EPA will implement as a matter of policy). EPA also issued a fact sheet on five-year review guidance to reinforce the guidance.

By the end of FY92, EPA had conducted a total of seven five-year reviews (six more than were reflected in the report for FY91). The six additional reviews were conducted by Region 1 at the Auburn Road Landfill in New Hampshire and at the McKin Company site in Maine; by Region 5 at the FMC Corporation and the Kummer Sanitary Landfill in Minnesota; and by Region 8 at the Rose Park Sludge Pit in Utah and the Rocky Mountain Arsenal in Colorado. Three of the reviews were statutory (Auburn Road, Kummer Sanitary Landfill, and Rocky Mountain Arsenal). Three were policy reviews (FMC Corporation, McKin Company, and Rose Park Sludge Pit). At all of these sites, EPA determined that the remedies remain protective of human health and the environment. EPA will conduct future five-year reviews consistent with CERCLA Section 121(c) and Agency guidance.

At the Auburn Road site, the Kummer Sanitary Landfill, the McKin Company site, and the Rocky Mountain Arsenal, no recommendations for action were necessary as a result of the five-year reviews. At the FMC Corporation site, the Region recommended to continue O & M activities under way. At the Rose Park Sludge Pit, the Region recommended development of more enforceable deed and land use restrictions. Subsequently, those restrictions were negotiated, and the site was proposed for deletion from the NPL.